

Subject: Protection of flight crew compartment (Smoke and fumes)	Date: DRAFT Initiated By: ANM-115	AC No: 25.795 (b) (1) Change:
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TABLE OF CONTENTS

<u>Paragraph</u>	<u>Page</u>
1. PURPOSE.....	1
2. RELATED FAR SECTIONS	2
3. BACKGROUND	2
4. DISCUSSION.....	2
5. SPECIAL CONSIDERATIONS.....	3
6. COMPLIANCE.....	3

1. PURPOSE:

This Advisory Circular provides a means, but not the only means, of demonstrating compliance with § 25.795(b)(1) and discusses the rulemaking action which implements ICAO Annex 8, Appendix 97 Standards, pertaining to an aircraft design requirement that there be means to minimize entry into the flight crew compartment of smoke, fumes and noxious vapors generated by a fire from an explosion, which occurs outside of the flight deck in the airplane.

The means of compliance described in this document is intended to provide guidance to supplement the engineering and operational judgment that must form the basis of any compliance findings relative to the certification requirements.

The guidance provided in this document is intended for airplane manufacturers, foreign regulatory authorities, and Federal Aviation Administration transport-airplane type-certification engineers and their designees.

As with all advisory circular materials, this AC is not, in itself, mandatory, and does not constitute a regulation. It is issued to describe an acceptable means, but not the only means, for demonstrating compliance with the requirements for transport category airplanes. Terms such as 'shall' and 'must' are used only in the sense of ensuring applicability of this particular method of compliance when the acceptable method of compliance described in this document is used.

This advisory circular does not change, create any additional, authorize changes in, or permit deviations from, regulatory requirements.

2. RELATED FAR SECTIONS:

Title 14, Code of Federal Regulations (14 CFR) Parts 25:

§ 14 CFR 25.795

§ 14 CFR 25.831

§ 14 CFR 25.855

§ 14 CFR 25.857

3. BACKGROUND:

Prior to the adoption of Amendment 25-XX, the regulations did not specifically address the penetration of smoke into the flight deck except from a cargo compartment fire as required by 25.855(h)(2) and 25.857(c)(3). The regulation FAR 25.831(d) deals with smoke clearance from the flight deck. Specific guidelines are given in AC 25-9A for smoke penetration, smoke detection and smoke clearance. It describes the method of testing, including equipment requirements, test procedures and pass/fail criteria. This AC does not change any of those guidelines.

Current test procedures in AC25-9A do not allow for any smoke penetration into the flight deck from a cargo compartment. This AC recognizes and permits that some smoke may initially permeate the flight deck after an explosion or fire occurs anywhere else on the airplane. This is consistent with smoke test procedures used in the E/E bay.

4. DISCUSSION:

It is intended that the flight deck be protected from excessive penetration of smoke, fumes, and noxious vapors generated by explosions or fires anywhere on the airplane other than the flight deck.

As noted above, the current test procedures in AC25-9A do not allow any smoke penetration into the cabin and flight deck emanating from a fire in the baggage compartment. Section 25.795(b)(1) assumes that smoke, fumes, and noxious vapors resulting from the detonation of an explosive device may initially enter the flight deck until procedures are initiated to prevent smoke entry.

Flight deck ventilation systems are designed to supply relatively large quantities of air to meet the ventilation and temperature requirements. It has been shown in airplanes {Technical Note DOT/FAA XXX} that sufficient airflow rates can prevent smoke and gases

from entering the flight deck by creating a small differential air pressure between the flight deck and the cabin and/or adjacent compartments. With the flight deck door closed, a pressure boundary can be developed, driving air from the flight deck into the compartments adjacent to the flight deck through the gaps and openings with a velocity related to the gap size and pressure differential. The minimum pressure differential needed to prevent smoke entry has been found to be too small to accurately measure directly with instrumentation. However, covering the flight deck door opening with a thin sheet of plastic provides a flexible barrier that will noticeably deform when a light pressure differential exists. Anytime the plastic deflected towards the passenger cabin, smoke was prevented from entering the flight deck. This provides a visual method that can be used to demonstrate compliance. A good design practice would include minimizing possible routes of smoke entry (e.g. electronic equipment cooling systems, doors and floor gaps, clearances between the bulkhead and supporting structure, etc.).

5. SPECIAL CONSIDERATIONS:

The following special considerations shall be observed:

- a. The flight deck door is assumed to be closed. The flight crew would be expected to assure that the flight deck door is closed to block smoke entry.
- b. *No structural or systems damage need be considered.* The airplane structure and the systems are assumed to be functional for the purpose of demonstrating compliance. No reduction in performance is assumed in systems operations or airplane capabilities.
- c. *The airplane must be assumed to be operating under any phase of flight.* The applicant shall provide protection from excessive smoke penetration into the flight deck, regardless of the location and origin of the fire and during any flight phase, except as follows. This does not apply to short duration air conditioning “packs off” operations during take-off and initial climb, “packs off” operations during a “go-around”, landing procedures requiring a “hold” in the descent phase, or during idle descent operations. The ventilation system settings and distribution configuration should also be considered so that the design goal of providing protection from excessive smoke, fumes and noxious vapor penetrations into the flight deck is not compromised by other settings/procedures.
- d. *The flow behavior of smoke, fumes and noxious vapors is assumed to be identical to visible smoke.* The detection and removal of smoke is assumed to equally remove any fumes and noxious vapors that are present.
- e. *Fresh air must be used to achieve the required airflow to the flight deck in the presence of smoke.*

6. COMPLIANCE:

A positive pressure differential between the flight deck and any adjacent compartments,

taking into consideration temperature, buoyancy, and altitude effects, must be attainable in all certificated configurations.

Compliance may be shown by analysis and/or flight testing.

- a. Analysis – Analysis may be used to verify that a positive pressure differential between the flight deck and any adjacent compartment is met for the required airplane flight conditions. The applicant needs to be able to verify that the analysis accurately represents actual flight conditions.
- b. Test Demonstration - A 0.005-inch thick, or thinner, sheet of polyethylene may be attached to the top, sides and bottom of the door opening with the flight deck door fully opened or removed. The plastic should be sealed so that no air gaps exist around the entire perimeter of the door opening. Sufficient polyethylene should be used so that it can deflect at least 6 inches when light pressure is applied. With the airflow settings properly selected, the polyethylene sheet must deflect away from the flight deck. The center of the sheet will then be forced toward the flight deck past its neutral position and then released. If the sheet again deflects away from the flight deck past its neutral position within 10 seconds, a sufficient pressure differential has been demonstrated to meet this requirement. All flight conditions, except as noted in paragraph 5(c), must be demonstrated.
- c. Smoke tests may also be conducted using the guidance provided in AC 25-9A Prior to generating any smoke, select the airflow settings designed to protect the flight deck from excessive penetration of smoke, fumes and noxious vapors. Wisps of smoke that enter and immediately exit at the occupied compartment boundaries are acceptable as long as a light haze or stratified haze does not form.